NON-PUBLIC?: N
ACCESSION #: 8712150044
LICENSEE EVENT REPORT (LER)

FACILITY NAME: McGuire Nuclear Station - Unit 2 PAGE: 1 of 6

DOCKET NUMBER: 05000370

TITLE: REACTOR TRIP DUE TO LOSS OF MAIN FEEDWATER PUMP BECAUSE OF LOW
CONDENSER VACUUM AS A RESULT OF A FAILURE TO FOLLOW PROCEDURE -
PERSONNEL ERROR
EVENT DATE: 11/05/87 LER #: 87-019-00 REPORT DATE: 12/07/87

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT: On 11/05/87 at 0646, the Unit 2 Reactor tripped due to a low-low level in Steam Generator 2B. The Main Turbine tripped because of the Reactor Trip. Operations (OPS) determined that an air bubble from a Unit 1 heat exchanger had migrated from Unit 1 to Unit 2 through crossover piping to the Unit 2 Main Feedwater Pump Turbine (CFPT) 2B Condenser Waterbox. The air bubble caused a loss of cooling efficiency in the condenser resulting in a low vacuum in the CFPT 2B Condenser. CFPT 2B tripped initiating a Reactor/Turbine Runback; the Digital Electro Hydraulic Turbine Control system did not respond correctly, and the Reactor tripped on a Steam Generator 2B Low-Low Level signal. OPS vented the air out of the Main Feedwater Pump Condenser and vacuum was restored to the CFPT 2B Condenser, and Unit 2 entered Mode 1 (Power Operation) at 0945 on 11/06/87. During air sparging of Unit 1 Containment Spray (NS) Heat Exchanger (HX) 1A, Mechanical Maintenance personnel did not open the HX vent valve as instructed in the procedure; therefore, this event is classified as Personnel Error. Performance will initiate a safety reveiw of the NS HX Cleaning process relative to air leakage into the Nuclear Service Water (RN) header and other RN components.

(End of Abstract)

INTRODUCTION:

On November 5, 1987 at 0646, the Unit 2 Reactor (EIIS:RCT) tripped because of a low-low level in Steam Generator (EIIS:SG) 2B. The Main Turbine (EIIS:TRB) tripped because of the Reactor Trip. Operations determined that an air bubble from a Unit 1 heat exchanger (EIIS:HX) had migrated from Unit 1 to Unit 2 through crossover piping to the Unit 2 Main Feedwater (EIIS:SJ) Pump (EIIS:P) Turbine (EIIS:TRB) 2B Condenser (EIIS:COND) Waterbox. The air bubble caused a loss of cooling efficiency in the condenser resulting in a low vacuum in the Main Feedwater Pump Turbine 2B Condenser. Main Feedwater Pump Turbine 2B tripped initiating a Reactor/Turbine Runback; the Digital Electro Hydraulic Turbine Control system (EIIS:JJ) did not respond correctly, and the Reactor tripped on a Steam Generator 2B Low-Low Level signal. Vacuum was restored to the Main Feedwater Pump 2B Turbine Condenser, and Unit 2 entered Mode 1 (Power Operation) at 0945 on November 6, 1987.

Unit 2 was in Mode 1, Power Operation, at 100% power, and Unit 1 was in Mode 5, Cold Shutdown, at the time of this event.

During air sparging of Unit 1 Containment Spray (NS), (EIIS:BE) Heat Exchanger 1A, Mechanical Maintenance personnel did not open the heat exchanger vent valve (EIIS:VTV) as instructed in the procedure; therefore, this event is classified as Personnel Error.

EVALUATION:

Background

The Nuclear Service Water (RN) system (EIIS:BI) is a Nuclear Safety Related, open cooling system that provides cooling water from Lake Norman or the Standby Nuclear Service Water Pond to various essential and nonessential station heat exchangers during all modes of operation. Units 1 and 2 RN system suctions are normally aligned to the low level Condenser Circulating Water (RC) system (EIIS:SQ) intake. The normal alignment for Units 1 and 2 RN system discharges are to the RC discharge through RC crossover piping. One of the essential loads supplied by the RN system is the Containment Spray (NS) heat exchangers. The Main Feedwater (CF) pump turbine condensers are cooled by the RC system.

The NS Heat Exchanger Cleaning Procedure is scheduled to be completed on an annual basis by the Periodic Test/Preventative Maintenance program. This procedure provides a method for cleaning the NS Heat Exchangers on the RN

side. Section 11.6 of the procedure provides instructions for air sparging (to agitate by means of compressed gas) the RN side (shell side) of the heat exchanger.

Description of Event

On November 5, 1987 at approximately 0643, an annunciator in the Control Room alarmed indicating a low vacuum in the CF Pump 2B Turbine Condenser. At 0643:49,

CF Pump Turbine 2B tripped because of the low vacuum in the condenser. The loss of CF Pump 2B immediately initiated a Reactor/Turbine Runback. The Digital Electro Hydraulic (DEH) Turbine Control system reduced the Main Turbine Generator load to approximately 800 MW (approximately 70% Reactor power) and then began cycling between 750 MW and 800 MW. The DEH Turbine Control system should have reduced the generator load to approximately 600 MW (approximately 50% Reactor power). Control Room personnel took manual control of the Main Turbine and reduced load to approximately 600 MW. The Control Room operators thought that they had steadied Unit 2 at approximately 50% power, but Steam Generator (S/G) levels continued to drop. At 0646:32, the Unit 2 Reactor tripped on a S/G 2B Low-Low Level signal.

Approximately 30 minutes after the Reactor Trip, CF Pump 2A Turbine tripped on low condenser vacuum. At this same time, the low vacuum alarm for the CF Pump 2B Turbine Condenser alarmed again. Operations (OPS) investigated the reason for the low vacuum alarms and determined that an air bubble from air sparging of a Unit 1 NS Heat Exchanger had migrated to the CF Pump Turbine Condenser Waterboxes through RN and RC crossover piping. The air bubble had reduced the heat transfer efficiency of the condensers causing the low vacuum in both condensers.

OPS implemented the Reactor Trip Recovery Procedure, AP/2/A/5500/01. OPS restored vacuum to the CF Pump 2A and 2B Turbine Condensers, and Unit 1 entered Mode 1 on November 6, 1987 at 0945.

Conclusion:

The air sparging of the NS Heat Exchangers is controlled by Section 11.6 of the NS Heat Exchanger Cleaning Procedure, MP/O/A/7150/79. Step 11.6.2 directs Maintenance (MNT) to have OPS open the vent valve (valve 1RN-135) on the heat exchanger prior to starting the air sparge. The root cause of this event is that MNT Assistant Technician A failed to notify OPS to open the heat exchanger vent valve as specified by step 11.6.2 (instructions for

air sparging) of the heat exchanger cleaning procedure. Therefore, this event has been classified as Personnel Error.

Instructions for heating of the heat exchanger water in step 11.4.3 of the heat exchanger cleaning procedure directs MNT to open the heat exchanger vent valve if heat exchanger pressure begins to increase. Past experience has shown that pressure does build up in the heat exchanger during heating of the water. When performing this task in the past, the MNT person involved in this event has usually opened the vent valve during the heating sequence and left it open until the air sparging was completed. MNT Assistant Technician A had left the vent valve open during his previous shift, and when resuming the job on the next shift, he did not verify that the vent valve was open when he got to sequence 11.6.2 of the heat exchanger cleaning procedure. There was not a signoff in the procedure for sequence 11.6.2, and prior to this event it was not determined to be necessary. The MNT person performing the air sparging was experienced and was working closely with the responsible MNT Engineer who was not at the job site.

There was not an Employee Training Qualification System task identified for this maintenance activity at the time of this event.

The NS 1A Heat Exchanger Inlet Isolation valve (valve 1RN-134) (EIIS:ISV) and Outlet Isolation valve (valve 1RN-137) (EIIS:ISV) were closed and red tagged. Both valves are butterfly valves which are prone to leak. The retest for these valves consists of a timing test, and a seat leakage test is not required. With the heat exchanger vent valve closed, air pressure built up in the heat exchanger. Apparently the air bubble leaked out of the heat exchanger through the inlet or outlet isolation valve and migrated to the RC system.

When the DEH Turbine Control system started to runback the Main Turbine to 56% power, a time lag between the turbine impulse pressure transmitter and the turbine impulse pressure switch, both of which provide signals to the DEH Turbine Control system runback circuitry, caused the Main Turbine load to oscillate. The Main Turbine load did not decrease as fast as the impulse pressure, and the DEH Turbine Control system terminated the runback with turbine load still at approximately 70% Reactor power. The DEH Turbine Control system brought turbine impulse pressure back up to match the MW load. The runback started again, and the load oscillated until OPS took manual control of the Main Turbine. This is the second runback that has occurred with the new DEH Turbine Control system. More severe oscillations were experienced during the first runback which hid this present problem. Correcting the first problem exposed the oscillation

problem experienced during this runback. The new DEH Turbine Control system is still in a debugging/fine tuning process.

The DEH Turbine Control System Vendor and Instrumentation and Electrical (IAE) made a software change to remove the MW feedback loop from the runback control circuitry. (This change was also made on Unit 1.) Runbacks will be controlled by turbine impulse pressure only; therefore, this problem should be eliminated. IAE have initiated a study to delete the pressure switch from the turbine control system, using the impulse pressure transmitter in place of the switch input. If the pressure switch is deleted, the MW feedback loop will be reinserted into the runback control circuitry.

The primary and secondary systems responded as expected during this Reactor Trip. The maximum S/G pressure reached was 1120 PSIG, which is below the open setpoints of the S/G Power Operated Relief Valves (PORVs) (EIIS:RV) and S/G Code Safety Valves (EIIS:RV), and the valves did not open. Pressurizer (EIIS:PZR) pressure reached 2300 PSIG which is below the open setpoints of the Pressurizer PORVs and Pressurizer Code Safety Valves, and the valves did not open. The Low-Low S/G Level signals actuated the Auxiliary Feedwater (CA) system (EIIS:BA) and the CA pumps started to feed the S/Gs.

The Steam Dump to Condenser valves responded properly and modulated as necessary to provide a heat sink for the Reactor. One Steam Dump to Condenser Valve, valve 2SB-6, did not indicate open on the Operator Aid Computer (OAC). OPS had written a work request on August 16, 1987 to investigate and repair the limit switches on

valve 2SB-6. All times used in the trip investigation report were from the OAC; a new Events Recorder has been installed at McGuire and it lacks the necessary points to provide the accurate sequence of events and times that had been possible in the past with the old Events Recorder.

During this event, OPS responded to the transient in a timely manner to stabilize the unit. All primary and secondary key parameters were at approximate no-load condition thirty minutes after the trip with the exception of S/G levels. The low S/G levels were due to the load oscillations during the runback, the loss of feedwater flow, and possible degraded operation of CF Pump 2A because of air in the condenser waterbox. All S/G levels were satisfactorily recovered within 75 minutes of the trip.

A review of McGuire Reports revealed numerous Reactor Trips; therefore, this event would be considered a recurring event. There have been 5 previous

Reactor Trip events involving personnel error from 1985 to the present date. One previous Reactor Trip in January 1986, was caused by an air bubble in the CF Pump 2A Turbine Condenser Waterbox. At that time, the source of the air bubble was not determined. At the time of the January 1986 trip, Performance were cleaning NS Heat Exchanger 1A. Records are not exact as to the starting times of specific parts of the cleaning, and personnel recollection had to be relied on. The cleaning method was different in 1986 in that air was introduced into the heat exchanger with normal RN flow going through it. The air was expected to be carried with the RN flow out the normal discharge path. Some of the air probably got into the RC system and caused the 1986 trip. This event is considered recurring, but the events leading up to this trip would not have been prevented by corrective actions of the previous events.

This event is not reportable to the Nuclear Plant Reliability Data System (NPRDS).

CORRECTIVE ACTIONS:

mmediate: OPS implemented the Reactor Trip Procedure, AP/2/A/5500/01.

Subsequent: 1) OPS vented the air out of the CF pump condensers (RC side).

2) The DEH Turbine Control System Vendor and IAE removed the MW feedback loop from the turbine runback control circuit.

Planned: 1) Performance will initiate and/or perform a safety review of the NS Heat Exchanger cleaning process relative to air leakage into the RN header and other RN components.

SAFETY ANALYSIS:

An analysis of loss of normal feedwater flow is presented in Section 15.2.7, Loss Of Normal Feedwater Flow, of the Final Safety Analysis Report (FSAR). A loss of normal feedwater results in a reduction of capacity of the secondary system to

remove the heat generated in the Reactor core. The Reactor Trip on low-low S/G level in any S/G provides the necessary protection against a loss of normal feedwater. During this event, the CA system automatically started and was capable of removing the stored and residual (decay) heat from the Reactor, thus preventing either overpressurization of the Reactor Coolant system (EIIS:AB) or loss of water from the Reactor core. Therefore, this event is bounded by the accident analysis of FSAR Section 15.2.7.

The unit responded to the Reactor Trip without any significant problems. The key primary and secondary parameters were at their approximate no-load value 30 minutes after the trip with the exception of S/G levels. S/G D decreased to approximately 20% level and S/Gs A, B, and C decreased to approximately 10% level. All S/G levels were recovered to their no-load value approximately 75 minutes after the trip. The steam dump to condenser valves operated properly and modulated as necessary. Main Steam pressure did not reach the Main Steam PORV or Main Steam Code Safety valve lift setpoints and the valves were not challenged. Reactor Coolant pressure did not reach the Pressurizer PORV or Pressurizer Code Safety valve lift setpoints and the valves were not challenged. Adequate core cooling was maintained throughout this transient, and the Reactor Coolant system boundary was not challenged. Emergency power and/or emergency core cooling were not required in this event and were not actuated.

There were no personnel injuries, personnel overexposures, or releases of radioactive material as a result of this event.

This event is considered to be of no significance with respect to the health and safety of the public.

ATTACHMENT # 1 TO ANO # 8712150044 PAGE: 1 of 1

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December 7, 1987

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: McGuire Nuclear Station, Unit 2
Docket No. 50-370
Licensee Event Report 370/87-19

Gentlemen:

Pursuant to 10CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event

Report 370/87-19 concerning a Reactor trip that occurred on November 5, 1987. This report is being submitted in accordance with 10CFR 50.73(a)(2)(iv). This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

/s/ Hal B. Tucker
Hal B. Tucker

SEL/183/jgc

Attachment

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